

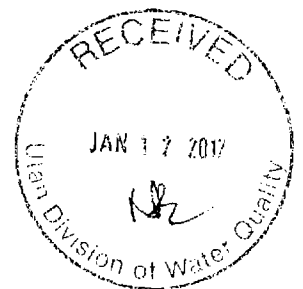
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Smithfield Hog Production

Groundwater Discharge Report and Application For Pinnacle Finisher Sites Millard and Beaver Counties, Utah

Prepared by
Joel A. Myers, P.E.
GEM Engineering, Inc.



January 6, 2017

Report Number: RE0469



DWQ-2017-002424

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DWQ-2017-000351

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January 6, 2017

Division of Water Quality

Utah Department of Environmental Quality

Salt Lake City, Utah 84114-4870

Subject: Groundwater Discharge Permit Application and Report
For Smithfield Hog Production
Pinnacle Finisher Farm Sites
North-Northeast of Milford, Millard and Beaver Counties, Utah

Enclosed are the application, required backup information and reports for the submission of the Utah Groundwater Discharge Permit Application for the project listed above. The project is to be located approximately 8 miles north-northeast of Milford, Millard and Beaver Counties, Utah.

We appreciate this opportunity to be of service on this phase of the project and look forward to being of service as the project progresses. If you have any questions, please contact this office at your convenience.

Sincerely,
GEM Engineering, Inc.



Joel A. Myers, P.E.
President



SECTION 2: DESCRIPTION OF PRODUCTION FACILITIES

The facilities are to be located approximately 8 miles north-northeast of Milford. These sites will be pairs of 4800 hog finisher sites with a primary waste containment basin and a secondary evaporative basin to contain the waste from the two 4800 hog sites. Anaerobic digestion of the waste will occur naturally over time as the waste sets in the containment basin.

Potential discharges would include the possible leaking of the basins or the pipes into or out of the facilities. Both the influent into and the effluent out of the facility will be closely monitored. Therefore, any leakage will be identified by a corresponding drop in the amount of either influent or effluent. Furthermore, in compliance with groundwater discharge permit requirements, monitoring wells will be installed to verify that the groundwater is not contaminated due to sewage leakage.

2.1 Farm Site Population

There are 33 sites proposed for this permit. The sites will consist of two 4800 head finisher barns at each site containing pigs sized from 14 to 250 pounds. Table 1-2 summarizes the swine population anticipated for the farm sites:

Table 1-2

Animal Type	Average Animal Weight (lbs)	Population	Total Live Animal Weight (LAW) for Animal Type (lbs)
Finisher Pig	135	9600/site	1,296,000/site

2.2 Farm Site Location

The locations of the finishing farms are identified on Attachment 2. Table 1-3 indicates the latitude and longitude of the sites.

Table 1-3

Farm Number	Latitude	Longitude
1-2	N 38° 29' 06"	W 112° 58' 19"
3-4	N 38° 29' 41"	W 112° 53' 39"
5-6	N 38° 30' 00"	W 112° 58' 56"
7-8	N 38° 30' 03"	W 112° 57' 19"
9-10	N 38° 30' 09"	W 112° 56' 18"
11-12	N 38° 30' 25"	W 112° 55' 00"
13-14	N 38° 30' 49"	W 112° 58' 59"
15-16	N 38° 30' 46"	W 112° 57' 18"
17-18	N 38° 30' 57"	W 112° 56' 19"
19-20	N 38° 31' 00"	W 112° 54' 01"
21-22	N 38° 31' 40"	W 112° 58' 18"
23-24	N 38° 31' 29"	W 112° 57' 19"
25-26	N 38° 31' 42"	W 112° 56' 26"
27-28	N 38° 31' 58"	W 112° 54' 58"
29-30	N 38° 32' 06"	W 112° 54' 04"
31-32	N 38° 31' 49"	W 112° 52' 52"
33-34	N 38° 32' 38"	W 112° 57' 44"
35-36	N 38° 32' 33"	W 112° 56' 13"
37-38	N 38° 32' 42"	W 112° 54' 59"
39-40	N 38° 32' 54"	W 112° 53' 30"
41-42	N 38° 32' 59"	W 112° 57' 20"
43-44	N 38° 33' 28"	W 112° 57' 43"
45-46	N 38° 33' 24"	W 112° 56' 04"
47-48	N 38° 33' 26"	W 112° 54' 21"
49-50	N 38° 34' 18"	W 112° 54' 25"
51-52	N 38° 35' 38"	W 112° 54' 55"
53-54	N 38° 35' 30"	W 112° 53' 23"
55-56	N 38° 35' 40"	W 112° 51' 41"
57-58	N 38° 36' 10"	W 112° 53' 48"
59-60	N 38° 36' 10"	W 112° 52' 49"
61-62	N 38° 36' 29"	W 112° 54' 55"
63-64	N 38° 36' 56"	W 112° 53' 49"
65-66	N 38° 36' 55"	W 112° 52' 48"

SECTION 6: CONTAINMENT BASIN SYSTEM LOCATION AND DESIGN

6.1 Containment Basin Description

A containment basin will be used at each finisher site to store the swine manure produced at the finisher sites. Effluent will be collected from the production building in an anaerobic Containment Basin where the effluent will be allowed to evaporate. The anaerobic Containment Basin will be lined. The liners will consist of a Flexible Membrane Liner (FML).

6.2 Containment Basin Site Soils Investigation

A soil and water table investigation was performed near the proposed Containment Basin locations. The soil investigations consisted of 2 backhoe trenches approximately 12 feet in depth near the proposed farm sites. The groundwater underlying the Containment Basin is at least 8 feet below the existing ground level. In order to meet DEQ criteria for Containment Basin construction, the seasonal high water table elevation must be at least 2 feet below the floor of the Containment Basin in hydrogeologically stable soil strata. At the proposed farm site the seasonal high water table was more than 2 feet below the bottom of the proposed Containment Basin. Also, the soil strata underlying the Containment Basins appear to be hydrogeologically stable. It is proposed that containment basin be placed approximately 5 feet below the ground surface at these farm site locations.

6.3 Containment Basin Design

The containment basins will be constructed with 60 mil HDPE liners as described in section 7 of this report and in accordance with the State of Utah Department of Environmental Quality regulations. A plan view and cross section of the containment basin can be found in Attachment D.

Similar sites have shown that the treatment volume required for finisher pigs is 1.20 cubic feet per pound of live animal weight (LAW) at the site's maximum expected population. An additional 0.60 cubic feet of volume per pound of LAW is then added for sludge accumulation.

The containment basin is designed to provide a surface area that will provide sufficient evaporative potential to evaporate inflow in the system on a continuous basis. The containment

basin will have 2.5 feet of freeboard and an additional 6 inches of depth to accommodate the incident rainfall from a 25 year-24 hour storm.

Table 1-5
Anaerobic Lagoon Design Criteria

	Evaporation System Design Criteria for finisher pigs (ft ³ /lb LAW)	Design Depth Constraints (feet)
Waste Treatment	1.20	-
20 Year Sludge Accumulation	0.60	-
Waste Storage	-	-
Waste Storage Evap. System*	Varies with facility water use*	-
25 year 24 hour Storm, plus direct precip. minus evaporation	-	0.50'
Freeboard	-	2.50'
Total	1.80*	3.00'

* Evaporative systems are designed based on surface area, not accumulated volume. However, sufficient capacity to allow some accumulation of liquid during times of low evaporations is necessary. The entire treatment system provides sufficient capacity to evaporate inflow into the system on a continuous basis.

Based on the LAW as defined in Table 1-2 and the design criteria defined in Table 1-5, containment basin dimensions were developed for the finishing farm sites. For the anaerobic lagoon system the treatment and sludge volumes were included along with the 25-yr, 24-hr storm and freeboard allowances. A schematic diagram of the waste storage system is shown in Attachment D project documents.

Table 1-6
Containment Basin Dimensions

Farm Type	Finisher
Live Animal Weight (pounds animal/site)	1,296,000
Treatment & Sludge Volume (ft ³)	2,332,800
Liquid Depth (ft)	22.5'
Freeboard (ft)	2.5'
Total Depth (ft)	25'
Bottom Dimensions (ft x ft)	225' x 225'
Liquid Level Dimensions (ft x ft)	405' x 405'
Top Inside Berm Dimensions (ft x ft)	435' x 435'

6.4 Waste Transfer System

Waste from the barns is transferred to the containment basin through either 8" SDR 32.5 HDPE or 8" SDR 35 PVC sewer pipe, installed at a 0.5% minimum slope. The effluent pipe and Containment Basin elevations allow the waste to gravity flow from the pits to the Containment Basin. The waste will then digest aerobically in the containment basin.

6.5 Containment Basin Safety System Considerations

Access to the Containment Basins by humans and animals will be controlled by fencing. The fences will help to prevent damage to the Flexible Membrane Liners (FMLs) in the instances where they are used. Only authorized personnel will have access to the Containment Basin areas to prevent damage to the FMLs. Additionally, safety-warning signs will be posted near the Containment Basins.

6.6 Containment Basin Management Plan

The Containment Basin is designed to contain all of the waste produced by the hogs for 20 years. When the sludge accumulation is near the design life of the basin the sludge will be pumped and dried then applied to local fields at agronomic rates. The prevailing climatological conditions result in more evaporation than precipitation. In wet years and when the sludge accumulation of

sludge reaches the design life excess waste water will flow into the evaporative basin and evaporate. It should be noted that evaporation exceeds precipitation in this area. Waste flow will not exceed the capacity of the primary and secondary basins.

SECTION 7: LAGOON AND CONTAINMENT BASIN CONSTRUCTION

7.1 Containment Basin Construction

Construction of the Basins and Containment Basin shall be done in accordance with design drawings and specifications. Earthwork and liner construction shall be tested and inspected by qualified independent geotechnical and/or engineering firms. At the completion of construction, and prior to operation of the facility, an independent performance certification document will be completed by a qualified professional engineer licensed in the State of Utah containing test information and certification that basin and liner construction meets requirements of the project design documents and the requirements contained within this report.

7.1.1 General Earthwork Construction

Earthwork and dike construction for excavation of digesters and equalization basins shall be done as follows:

- A. The area scheduled for construction of basins and building pads shall be cleared and grubbed to remove topsoil and surface vegetation from the digester/basin areas.
- B. Soil shall be excavated from the basin area and be used to construct building pads or dikes.
- C. Basin dikes shall be constructed in 6-inch compacted lifts to obtain proper compaction. For building pad and digester dike construction, the soil shall be moistened and compacted to 90% of maximum dry density, as defined by AASHTO T-99. Moisture will be added to the soil during compaction to target 2% above the optimum moisture.
- D. The dikes will be constructed of relatively impermeable compacted native material.
- E. A qualified inspector will perform the moisture content and dry density testing per every two feet of lift at random locations once every 400 feet along the Containment Basin dikes.

7.2 Flexible Membrane Liner

Specifications for manufacture, delivery, subgrade preparation, installation, and testing for FML liner installation are included in **Attachment E**. The QA/QC plan is also included in this

attachment. The specifications were adapted from requirements set forth in previous projects and permit applications. Moreover, an industry standard known as the GRI standard GM13 which covers smooth and textured geosynthetics has been developed with the intent of forming an industry standard for manufacture and testing of geosynthetic liner material. This standard was developed by the Geosynthetic Research Institute at Drexel University, Philadelphia, PA. As stated in the specifications, the requirements of latest revision of the GRI standard will be applicable.

If the basins are to remain empty for an extended period of time they shall be properly ballasted using ultraviolet ray resistant sand bags with nylon ties. The minimum specification for ballasting liner is 30-lb. sand bags spaced 5-feet apart along the entire toe of dike in containment basins. Sand-filled HDPE tube or pipe may also be used as long as an equivalent amount of ballasting per lineal foot (6 lbs./ln.-ft.) is maintained.

On occasion, repairs may have to be made to liners if damage occurs out of the norm, or modifications need to be made. All repairs made to liner seams, or incident holes found in the liner shall be vacuum/bubble tested, documented and sent to the State DEQ for informational purposes and approval of the repairs. Unless significant modifications to the liner are made, such repairs shall be made without any requirements for approval from the State DEQ.

7.2.1 Flexible Membrane Liner Installation

The Containment Basins at the finishing farms may be lined with a Flexible Membrane Liner (FML) constructed of a High Density Polyethylene (HPDE). The subgrade will conform to the FML specifications of the Manufacture and the previously stated most recent GRI standards. The installation of the FML will also comply with the Quality Assurance/Quality Control (QA/QC) found in Attachment E. In Addition to the FML specifications and QA/QC, detailed drawings of typical liner anchoring methods, pipe penetrations, air vents and water level markings of liners are found in attachment E. The following procedures will be used for installation of liners for the Containment Basins at the farm sites.

The Subgrade will be constructed according to the specifications as detailed below:

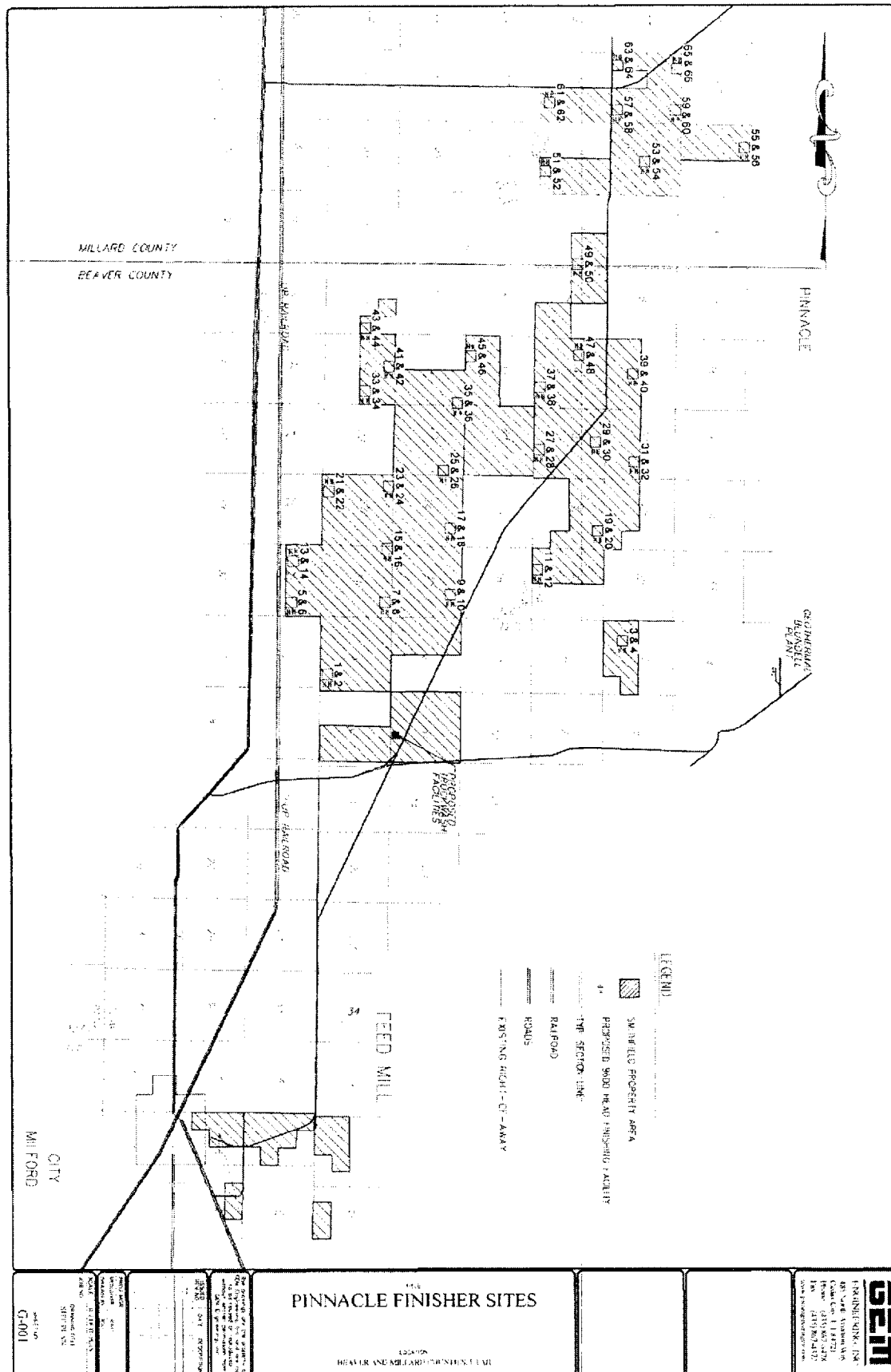
1. The subgrade material will come from either on-site material or approved stockpiles.
2. The earthwork for the anaerobic Containment Basins will be free of any foreign material such as stones greater than 3/8 inch in diameter, vegetation, brush, roots or similar material which could damage the FML.
3. The subgrade material shall be classified as either CH, CL, CL-MI, ML, SM, SC, SW or SP by the USCS Classification System.
4. A Moisture density curve will be developed for the subgrade material.
5. The minimum compacted thickness of the subgrade layer shall be 8 inches.
6. The subgrade will be compacted and graded to meet the FML contractor's specifications so as to avoid any ruts, irregularities or soft areas. The subgrade will be thoroughly compacted to provide support for the FML.
7. The subgrade will be compacted to a minimum of 90% maximum dry density as defined by AASHTO T-99. For proper compaction, moisture will be added to the soil during compaction to target 2% above the optimum moisture.
8. Installed density shall be confirmed by field test methods at a frequency of one test per 100'x100' grid square at the surface of the subgrade.

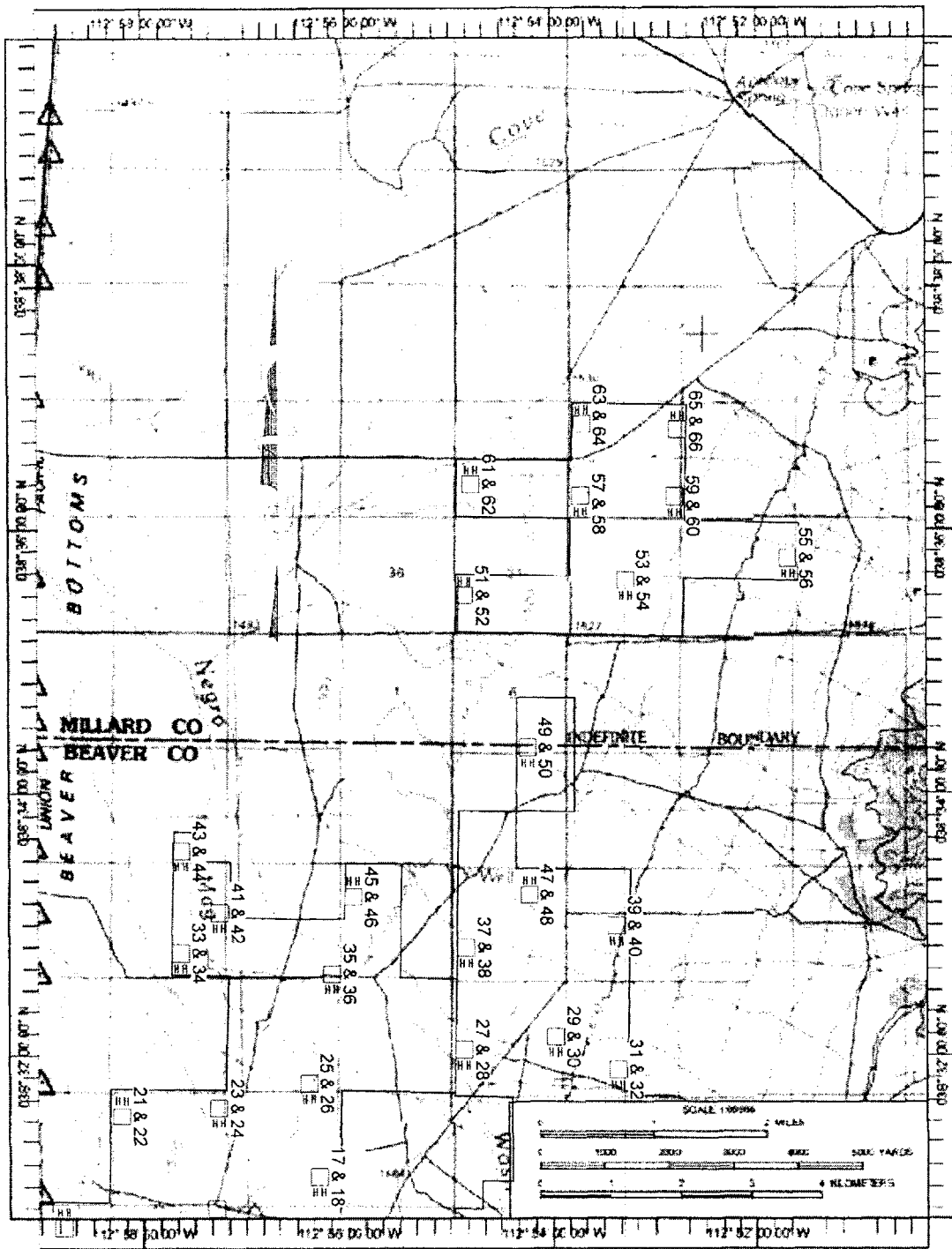
A 60-mil HDPE will be installed over the compacted subgrade. The HDPE material will meet the specifications indicated in the most recent GRI standard and in the QA/QC references in Attachment E. The drawings in Attachment E show typical liner anchoring methods and pipe penetrations of the liner material.

The HDPE liner will be installed according to the following procedure:

1. The earthwork for the anaerobic Containment Basins will be constructed so the subgrade will be free of any foreign material such as stones greater than 3/8 inch in diameter, vegetation, brush, roots or other similar materials which could damage the FML.

2. The earthwork will be compacted and graded to meet the FML contractor's specifications so as to avoid any ruts, irregularities or soft areas. The subgrade will be thoroughly compacted to provide support for the FML.
3. An anchor trench will be constructed along the crest of the berms for the purpose of securing the FML.
4. The FML will be assembled, seamed, tested and installed by the methods specified by a liner material recognized by the NSF (National Sanitation Foundation, Standard 54).
5. The FML will be certified as "holiday free" by electrical potentiometric means (spark tested) during manufacture.
6. Adequate slack will be maintained in the liner material during assembly and installation to minimize stresses due to variations in ambient temperature and incident radiation.
7. Heavily creased or otherwise defective liner material must be rejected.
8. Testing of coupons (strips of material) before seaming, stress cracks and all seams must be done in accordance with the manufacture's requirements.
9. Installation of the FML will ideally take place in temperatures ranging from 40 degrees Fahrenheit to 110 degrees Fahrenheit. In the event that the FML is installed during colder conditions (between 20 degrees Fahrenheit and 40 degrees Fahrenheit) the cold weather seaming procedures detailed in FML QA/QC, Attachment E, shall be followed.
10. Air Vents will be installed on all four sides of the Containment Basin as detailed in Attachment E and Compaction of the anchor trench backfill will provide a firm unyielding surface to secure the FML along the berms.

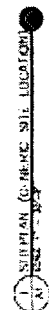




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GEM ENGINEERING, INC. 400 N. 10th Street Helena, MT 59601 Phone: (406) 261-1111 Fax: (406) 261-1112 E-mail: gem@mta.net	PINNACLE FINISHER SITES BEAVER AND MILLARD COUNTIES, MONTANA	This document is the property of GEM Engineering, Inc. and is not to be distributed, copied, or reproduced in any form without the written permission of GEM Engineering, Inc. DATE: 10/1/97 BY: J. J. JENSEN CHECKED: J. J. JENSEN APPROVED: J. J. JENSEN TITLE: PROJECT MANAGER PROJECT: Pinnacle Finisher Sites SHEET: 1 OF 1 DRAWING: G-002A
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Attachment D – Project Documents



SECRET
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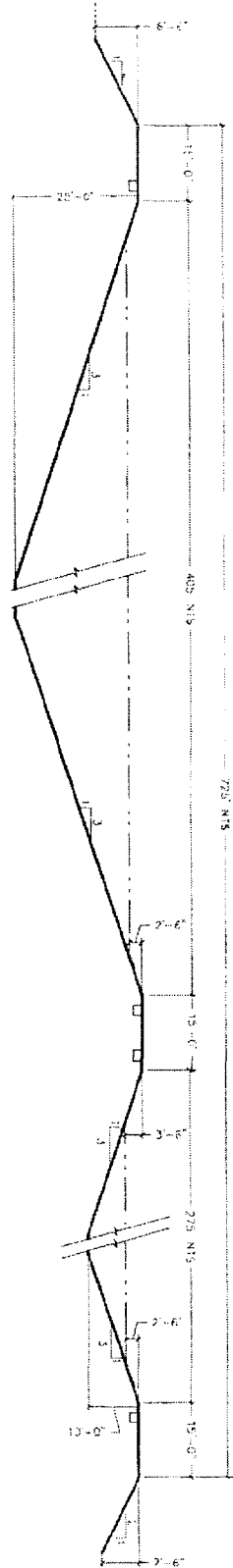


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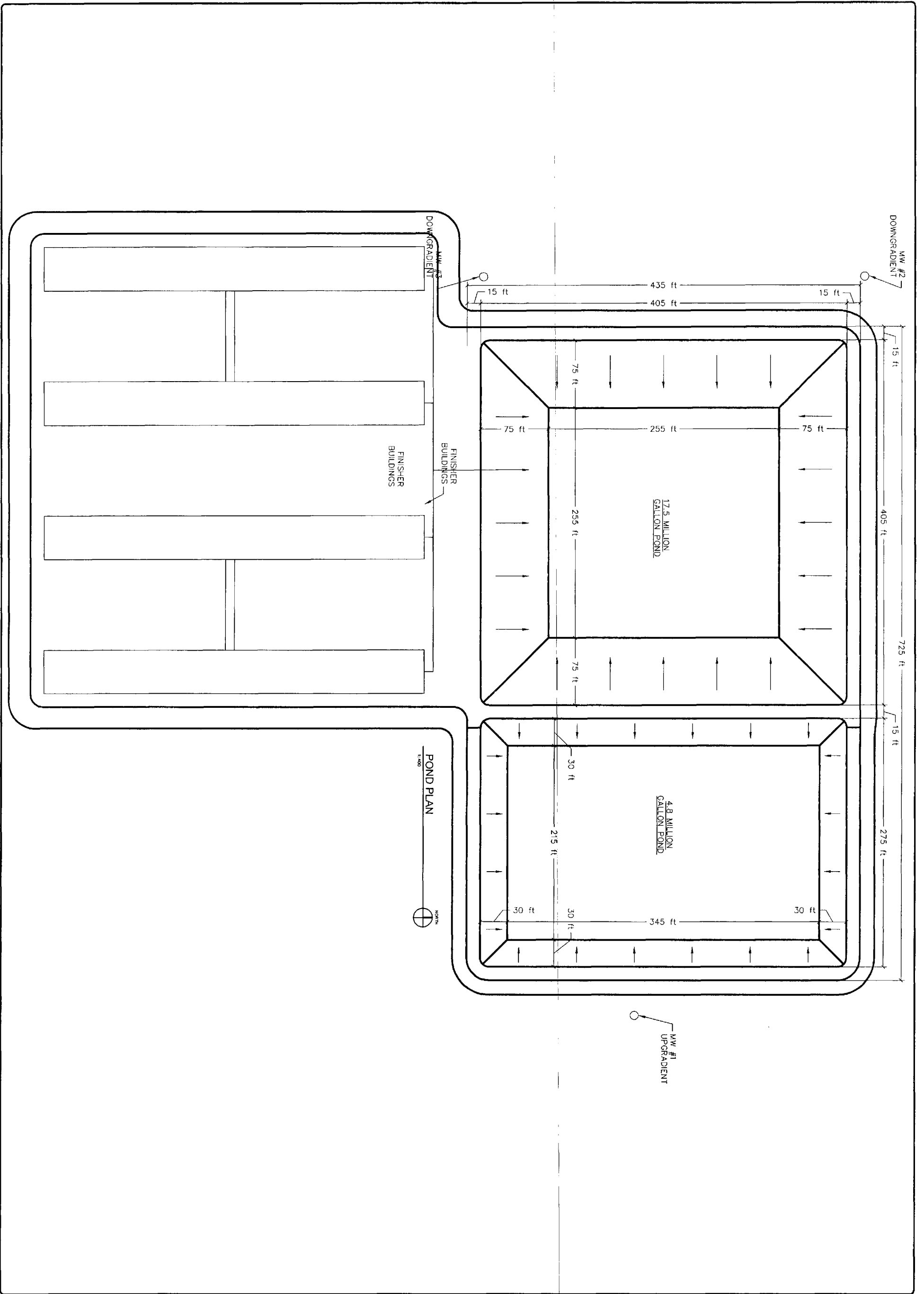
PINNACLE FINISHER SITES

LOCATION

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GEM ENGINEERING, INC. 485 North Aviation Way Cedar City, UT 84721 Phone (435) 867-6478 Fax (435) 867-4372 www.gemengineeringinc.com		TITLE: LOCATION: BEAVER AND MILLARD COUNTIES, UTAH																										
<p>The drawings are the property of GEM Engineering, Inc. and shall not be used, copied, or reproduced without written permission from GEM Engineering, Inc.</p> <table border="1"><thead><tr><th>ISSUED</th><th>REV</th><th>NO.</th><th>DATE</th><th>DESCRIPTION</th></tr></thead><tbody><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr></tbody></table>		ISSUED	REV	NO.	DATE	DESCRIPTION																					<p>PROJ. MGR.: ... DESIGNER: RWC DRAWN BY: RWC SCALE: REFER TO PLAN</p> <p>JOB NO.: ... DRAWING TITLE: POND PLAN AND MONITORING WELLS SHEET NO.: G-101.1</p>	
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Attachment E – Specifications and QA / QC for HDPE Liners

Specifications and QA / QC for HDPE Liners

1.0 SCOPE

- 1.1 These specifications describe High Density Polyethylene (HDPE) Lining Membranes. The supply and installation of these materials shall be in strict accordance with the Engineer's specifications and engineering drawings and be subject to the terms and conditions of the contract. The subgrade and the HDPE material will meet the specifications contained herein and in the GRI Test Method GM13.

2.0 MATERIAL

2.1 Physical Properties:

- A. The HDPE liner material used in this project shall be a minimum of 60 mil in thickness and have the properties as called out in Table 1(a) of GRI Test Method GM13 (Attachment G).
- B. Raw material shall be first quality polyethylene resin containing no more than 2% clean recycled polymer by weight.
- C. Melt Index (ASTM D1238 Condition 190/2.16): ≤ 1.0 g / 10 min.
- D. Dimensional stability in each direction at $\pm 2\%$ max (ASTM D 1204 – 100°C 1 hr).
- E. Environmental stress crack resistance of 1500 hrs min (ASTM D 1693 Condition B).
- F. The new membrane liner shall comprise HDPE material manufactured of new, first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures.
- G. The lining material shall be manufactured a minimum of 22.5 feet seamless widths. Labels on the roll shall identify the thickness, length and manufacturer's roll number. There shall be no factory seams.
- H. The liner material shall be so produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired using the extrusion fusion welding technique in accordance with the manufacturer's recommendations.
- I. The contractor shall, at the time of bidding, submit a certification from the manufacturer of the sheeting, stating that the sheeting meets physical property requirements for the intended application. FML rolls will not be installed, if any tested property is below the National Sanitation Foundation (NSF 54) minimum standard.

2.2 Handling:

- A. Delivery: Transportation of the geomembrane shall be performed by the geomembrane manufacturer through an independent trucking firm or other party as agreed by the owner.

Specifications and QA / QC for HDPE Liners

- B. Offloading: Geomembrane, when off-loaded, shall be placed on a smooth well drained surface, free of rocks or any other protrusions which may damage the material. No special covering is necessary for geomembrane. The following should be verified prior to off-loading the geomembrane:
 - 1. Handling equipment used on the site is adequate and does not pose any risk of damage to the geomembrane.
 - 2. Personnel informed of proper handling techniques and will do so with care.
- C. Any welding rod delivered to the site prior to the geomembrane installation contractor's arrival should be kept covered and dry or placed in a storage facility.
- D. Upon arrival at the site the geomembrane installation contractor shall conduct a surface observation of all rolls for defects and for damage. This inspection shall be conducted without unrolling rolls unless defects are found or suspected. The geomembrane installation contractor shall indicate any damage to the Project Manager / Owner.
- E. Storage: The Project Manager / Owner shall provide storage space in a location(s) such that on-site transportation and handling are minimized. Storage space should be protected from theft, vandalism, passage of vehicles, and be adjacent to the area to be lined.

3.0 MANUFACTURER

- 3.1 **Experience**: The manufacturer of the lining material specified in the previous section shall have previously demonstrated the ability to produce this membrane by having successfully manufactured a minimum of ten million square feet of similar liner material for hydraulic lining installations. The liner material provided by the manufacturer must be listed by the NSF (National Sanitation Foundation) Standard 54.

3.2 Factory Quality Assurance and Control

- A. Quality Assurance testing shall be carried out by the geomembrane manufacturer to demonstrate that the product meets this specification.
- B. Raw Material: All compound ingredients of the HDPE materials shall be randomly sampled on delivery to the HDPE manufacturing plant to ensure compliance with specifications. Tests to be carried out shall include Density ASTM D1505 and Melt Index ASTM D1238, Condition E.
- C. Manufactured Roll Goods: Samples of the production run shall be taken and tested according to ASTM D638 to ensure that tensile strength at yield and break, elongation at yield and break meet the minimum specifications. A quality control certificate shall be issued with the material.
- D. All welding material shall be of a type supplied by the manufacturer.

Specifications and QA / QC for HDPE Liners

- E. All FML material shall be certified as "holiday free" by electrical potentiometric means (spark tested) or other equivalent approved means. during manufacture.

3.3 Submittals: The geomembrane manufacturer shall submit the following information to the Project Manager / Owner:

- A. The origin (resin supplier's name, resin production plant), identification (brand name, number) and production date of resin.
- B. A copy of the quality control certificates issued by the resin supplier noting results of density and melt index.
- C. Reports on the tests conducted by the geomembrane manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls assigned to the considered facility (these tests should include specific gravity [ASTM D792 Method A or ASTM 1505 and melt index ASTM D1238 Condition 1902.16]).
- D. Reports on these tests conducted by the geomembrane manufacturer to verify the quality of the sheet.
- E. A properties sheet including, at a minimum, all specified properties, measured using test methods indicated in the specifications or equivalent.
- F. After receipt of material, the geomembrane manufacturer shall provide the Project Manager / Owner with one quality control certificate for every roll of FML provided. The quality control certificate shall be signed by a responsible party. The quality control certificate shall include: roll numbers, identification and results of quality control tests. As a minimum, the quality control certificates shall include the results of the geomembrane properties tested by the method and at the frequency shown in the table below.

Property	Test Method	Frequency
Thickness	ASTM D 751	Every Roll
Density	ASTM D 792/1505	Every 5 th Roll
Tensile Yield Strength	ASTM D 638	Every Roll
Yield Elongation	ASTM D 638	Every Roll
Tensile Break Strength	ASTM D 638	Every Roll
Break Elongation	ASTM D 638	Every Roll
Dimensional Stability	ASTM 1204	Every Roll
Tear Resistance	ASTM D 1004	Every Roll
Puncture Resistance	FRMS 101C-2065	Every Roll
Environmental Stress Crack Resistance	ASTM D 1693B	Every Roll
Carbon Black Content	ASTM D-1603	Every 5 th Roll
Carbon Black Dispersion	ASTM D-3015	Every Resin Lot

Specifications and QA / QC for HDPE Liners

4.0 INSTALLATION

4.1 Area Subgrade Preparation: The earthwork contractor shall be responsible for preparing the subgrade according to the basin's design and in accordance with the following specifications. If there is a discrepancy between the project design drawings and the following specifications the more stringent requirements shall apply.

- A. The earthwork shall be smooth and free of all rocks, stones, sticks roots, sharp objects, or debris of any kind. No stones or other hard objects that will not pass through a 3/8" screen shall be present in the top 1" of the surfaces to be covered. No vegetation, brush roots or other foreign material shall be present on the surfaces to be lined.
- B. The surface should be compacted so as to provide a firm, unyielding foundation for the membrane with no sudden, sharp or abrupt changes or break in grade. No ruts, irregularities or soft areas will be present on the surfaces to be lined. The subgrade shall be thoroughly compacted.
- C. No standing water or excessive moisture shall be allowed.
- D. An anchor trench shall be constructed in a square in accordance with detail DF3 / C.DF3 to secure the FML along the berm of the containment structure to be covered. See attached drawings at end of this specification for anchor and cover details.
- E. The installation contractor shall certify in writing that the surface on which the membrane is to be installed is acceptable before commencing work. The FML will be assembled, seamed, tested and installed by the methods specified by a manufacturer recognized by the National Sanitation Foundation, Standard 54.
- F. The subgrade shall be constructed so as to meet the following:
 - 1. The subgrade material will come from either on-site or from approved stockpiles.
 - 2. The earthwork for the anaerobic digesters and the equalization basins will be constructed so the subgrade will be free of any foreign material such as stones greater than 3/8 inch in diameter, vegetation, brush, roots or similar material which could damage the FML.
 - 3. The subgrade material will be classified as CH, CL, CL-ML, ML, SM, SC, SW or SP by the USCS Classification System.
 - 4. A moisture/density curve will be developed for the subgrade material.
 - 5. The minimum compacted thickness of the subgrade layer shall be 8".
 - 6. The subgrade will be compacted and graded to meet the installation contractor's specifications so as to avoid any ruts, irregularities and soft areas. The subgrade will be thoroughly compacted to provide support for the FML.

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7. The subgrade will be compacted to a minimum of 90% dry density. For proper compaction, moisture will be added to the soil in quantities comparable to the OMC.
8. Installed density shall be confirmed by field test methods at a frequency of one test per 200' x 200' grid square.
9. A written statement by an independent professional engineer regarding the subgrade's structural integrity, along with supporting data will be submitted with the liner certification packet.

4.2 Dike Construction: The earthwork contractor shall be responsible for constructing dikes according to the following specifications:

- A. The dike will be constructed of relatively impermeable material.
- B. Each lift shall not exceed 6 inches in depth.
- C. A geotechnical inspector will conduct compaction testing for each two vertical foot intervals at a frequency of 1 per every 400 linear feet.
- D. A written statement by an independent professional engineer regarding the dike's structural integrity, along with supporting data will be submitted with the liner certification packet.

4.3 Anchor Trench:

- A. The attached schematic detail DF3 / C.DF3 at the end of this specification indicates the anchor trench installation. Deviations from this design must be approved by the design engineer prior to use.
- B. Compaction of the anchor trench backfilling will be done promptly after installation of the FML.
- C. Compaction of the trench backfill shall include moisture added to the top 6 inches, with compaction done by a vibratory roller or tamper to firm unyielding surface.
- D. Final grading will be implemented to produce a smooth uniform finish that slopes away from the digester and basins.
- E. A client approved quality control technician shall inspect the anchor trench upon completion. Any portion of the anchor trench inadequately constructed will be re-dug and repaired in accordance with the specifications above.

4.4 Geomembrane Placement:

- A. The installation of the HDPE must be done by the manufacturer, or a manufacturer's authorized distributor, using the manufacturer's extrusion or hot wedge welding equipment and installation methods. All supervisors overseeing the liner installation must

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have five million square feet of supervisory liner experience. All field technicians must have one million square feet of seaming experience.

- B. Field Panel Identification: A field panel is the unit area of polyethylene which is to be seamed in the field, i.e., a field panel may be a complete roll or partial roll cut in the field. Smaller units used in the lining systems such as repairs, tabs, extensions, etc. need not be documented in the same manner as a field panel.

1. The installer will be responsible for marking each panel with the identification number and the appropriate manufacturer's roll number. It is suggested that the panel number be marked on each end of the panel, after each panel is placed, for ease of reference.

C. Field Panel Placement:

1. Placement Plan: Panel placement should take into account: site drainage (including sump or low point considerations), prevailing wind direction, subgrade construction, access to the site and the production schedule of the project. Adequate slack will be maintained in the liner material during assembly and after installation to minimize stress due to variations in ambient temperature and incident radiation.
2. Installation Sequence: Field deployed panels should be seamed as soon as possible after deployment to minimize the risk of wind or water damage.
3. Weather Conditions: Geomembrane panel deployment shall not proceed when ambient air temperature or adverse weather conditions exist which will jeopardize the integrity of the liner installation. Typically, installation shall not proceed when the ambient temperature is below 20°F or above 110°F. Special low temperature welding techniques may be required in conditions of ambient temperatures between 20°F and 40°F.
4. Geomembrane panel deployment shall not proceed if subgrade conditions have deteriorated due to moisture, or in the presence of high winds which might cause damage to the liner material. Deployed panels should be adequately ballasted at all times to limit the risk of wind damage.
5. Method of Deployment: The FML installation contractor shall proceed with deployment provided the following conditions are met. If the conditions below are not met the FML installation contractor shall cease deployment and resolve the problems with the Project Manager / Owner.
 - Any equipment used does not damage the subgrade.
 - The subgrade conditions have not deteriorated.
 - The subgrade is free of loose rocks, debris, ruts, etc.
 - The personnel who are in contact with the liner do not smoke wear damaging shoes or engage in other activities which risk damage to the liner.

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- Adequate sandbags are present to weight the edges of the liner to avoid wind uplifting.
 - Excessive traffic across the liner is avoided.
6. Damage: The FML installation manager and quality assurance technical shall visually inspect each panel, as soon as possible after deployment, for damage or areas needing repair. Appropriate marks indicating a need for repairs shall be done during the inspection. Heavily creased or otherwise defective material shall be rejected.

4.5 Field Seaming & Layout:

- A. Individual panels of liner material shall be laid out and overlapped by a maximum of four inches (101 millimeters) for extrusion weld prior to welding or five inches (127 millimeters) for hot wedge weld prior to welding. Extreme care shall be taken by the installer in the preparation of the areas to be welded.

All sheeting shall be welded together by means of integration of the extrudate bead with the lining material. The composition of the extrudate shall be identical to the lining material, or all sheeting shall be welded together using the hot wedge welding system.

- B. Seam Layout: In general, seams shall be oriented parallel to the plane of maximum slope, i.e., oriented along, not across the slope. In corners and odd shaped geometric locations the number of seams should be minimized. No horizontal seams should occur on a panel less than 5 lineal feet from the top of the slope. On slopes of less than 10% (6:1) this rule shall not apply. Seams will be installed at least four feet into the anchor trench.

1. A seam is considered a separate entity if it joins two panels. Repairs are not considered seams in this context.
2. A seam numbering system can be used to identify the seams. It is suggested that a simple numerical system be used or adjacent panel numbers can be utilized to identify the seam.
3. Seams will be welded to at least four feet into the anchor trench.

- C. Seaming Equipment and Products: Approved processes for field seaming and repairing are extrusion welding and fusion welding. All welding equipment should have accurate temperature monitoring devices installed and working to ensure proper measurement of the fusion welding wedge temperature or the extrusion barrel temperature.

- D. Extrusion Welding Process: This process shall be used primarily for repairs, patching and special detail fabrication and can also be used for seaming.

1. The extrusion welding apparatus (Handwelder) shall be equipped with gauges or other temperature monitoring devices to indicate temperature of the extrudate (resin) as well as the applicable pre-heat settings.
2. The FML installation contractor shall verify the following:

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- a. Equipment in use is functioning properly.
 - b. Welding personnel are purging the machine of heat-degraded extrudate prior to actual use.
 - c. All work by the personnel is performed on clean surfaces and done in a professional manner.
 - d. No seaming is done in adverse weather conditions.
- E. Fusion Welding Process: This process shall be used for seaming panels together and is not generally used for patching or detail work.
1. The apparatus may be of a hot wedge type and shall be equipped with a "split wedge", used for pressure type seam testing.
 2. Fusion welding equipment shall be self-propelled devices and shall be equipped with functioning speed controllers and monitors to assure proper control by the welding technician. The welding equipment used shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the lining material so as to ensure that changes in environmental conditions will not affect the integrity of the weld.
 3. The FML installation contractor shall verify the following:
 - a. Equipment in use is functioning properly.
 - b. Welding personnel are performing seaming in a professional manner and are attentive to their duties.
 4. **Figure F-1** below is a schematic detail which indicates acceptable fusion weld. Deviations from these must be approved by the design engineer prior to use.

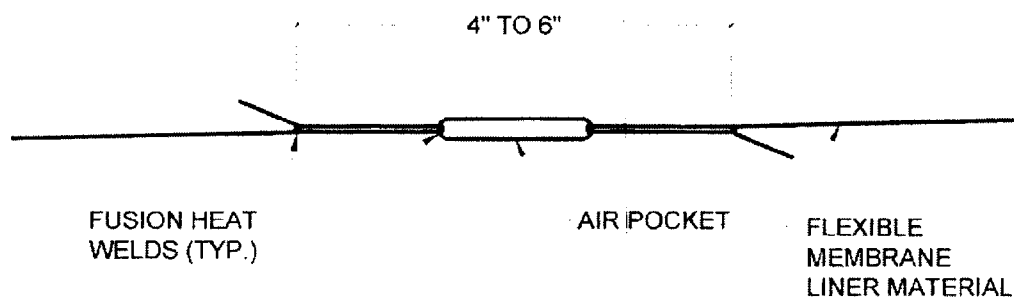


Figure F-1 – Typical Fusion Weld

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- F. Seam Preparation: The area to be welded shall be cleaned and prepared in accordance with this specification and the recommendations of the material manufacturer. The welding technician shall verify the following:
1. Prior to seaming the seam area shall be free of moisture, dust, dirt, sand or debris of any nature.
 2. Seam is overlapped for fusion welding.
 3. Seam is overlapped or extended beyond damaged areas at least 4" when extrusion welding.
 4. Seam is properly heat tacked and abraded when the extrusion welding is done.
 5. Seams are performed with the fewest number of unmatched wrinkles or "fish mouths".
- G. Fish Mouths: No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur the material shall be cut, overlapped and an overlap extrusion weld shall be applied.
- H. Slack: Adequate slack will be maintained in the liner during assembly and after installation to minimize stresses due to variations in ambient temperature and incident radiation.
- I. Defective Material: Heavily creased or otherwise defective liner material will be rejected.
- J. Weather Conditions for Seaming: No seaming shall be performed in ambient air temperatures or adverse weather conditions which will jeopardize the integrity of the liner installation. Ambient air temperatures shall not exceed 110°F nor be below 20°F during seaming. Additionally, seaming shall not proceed in conditions in which the liner is subject to dew or other condensation, rain, snow, frost or frozen subgrade.
- K. Low Temperature Welding Procedures: The most important criteria for performing welding when the ambient temperature is between 20°F to 40°F is the condition of the trial weld. All trial welds should be made in conditions duplicating the actual welding environment. The following procedures should be used to maintain the quality of the weld in low temperature ambient conditions (20°F to 40°F).
1. Conduct additional trial welds when a welding machine has been shut off, or after a major change in ambient conditions. A major change in ambient conditions would include but is not limited to the following:
 - a. Change in temperature of more than 20°F
 - b. Change in wind speed of more than 10 mph.
 - c. Change in the amount of sunshine on the liner.

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2. The geomembrane and extrudate material must be dry and free from frost, dew, condensation or other moisture.
 3. Hot wedge set temperatures may be increased up to 700°F in 10°F increments as necessary.
 4. The hot wedge rate of travel should be slowed as necessary.
 5. Length of trial weld seams should be increased to 5 ft for extrusion welds and 24 ft for fusion welds.
 6. Clean the seam area immediately in front of the welding apparatus with a clean dry cloth.
 7. Destructively test one specimen, no greater than 6" from the end of each seam to confirm the quality of the seam.
 8. Increase handwelder (extrusion welder) pre-heat temperature up to 600°F in 20°F increments as necessary.
 9. Increase handwelder extrudate temperature up to 530°F in 10°F increments as necessary.
 10. If additional measures are needed to produce acceptable welds the following additional measures may be implemented:
 - a. Install an insulating material such as a geotextile cushion beneath the seam being welded.
 - b. Use hot air pre-heat (additional pre-heat for extrusion welding) 6" to 12" in front of the welding apparatus (both fusion and extrusion welders). Verify weld quality by means of a trial weld.
 11. If trial welds still indicate that a quality weld cannot be produced by the above steps, a wind shield or an enclosure may be placed over the area to be welded. In the case of an enclosure, the enclosed area shall be heated by forced air or radiant means to an air temperature at or above 40°F.
 12. All trial welds will be documented with samples (failures and approved) recorded, retained with samples attached to completion submittal records.
- L. Temporary Bonding: The FML installation contractor shall verify that no solvents or adhesives are used in the seaming area. Tape or heat tacking is permissible for temporarily holding patches but is not a substitute for welding.
- M. Trial seams / Welds: Trial seams / welds shall be made on appropriate sized pieces of geomembrane material to verify that seaming conditions are adequate.

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1. Trial seams / welds shall be performed for each welder to be used and by each operator of extrusion welders, and by the primary operator of the fusion welder.
2. A passing trial seam / weld shall be made prior to seaming each day. If the apparatus is cooled down after use and additional trial seam may be required.
3. Fusion welded trial seams shall be approximately 5 foot long by 1 foot wide with the seam centered lengthwise. For extrusion welding the trial seam sample size shall be approximately 3 feet long by 1 foot wide with the seam centered lengthwise.
4. Test welds shall be marked with date, ambient temperature and welding machine number. All test weld samples will be retained and submitted with approved inspection reports.
5. Samples of weld $\frac{1}{4}$ " to $\frac{1}{2}$ " wide shall be cut from the test weld and pulled by hand in peel. The weld should not peel.
6. Refer to Quality Assurance and Quality Control Section 5.2.B for testing requirements.
7. The geomembrane installation contractor shall assign each trial seam / weld sample a number and record the test results in the appropriate log.
8. Upon passing, unless otherwise specified, all trial seam / weld specimens must be retained and submitted with approval inspection reports.

4.6 Defects and Repairs

- A. Once defective or areas requiring repair are identified as called out in Section 5.3. Each area shall be repaired in accordance with this section and non-destructively tested.
- B. Repair Procedures: Any portion of the polyethylene lining system exhibiting a defect which has been marked for repair shall be repaired with one or more of the following appropriate procedures:
 1. Repair Methods:
 - Patching: Used to repair holes, tears, un-dispersed raw materials in the sheet.
 - Grind and Re-Weld: Used to repair small section of extruded seams.
 - Spot Welding: Used to repair small, minor, localized flaws.
 - Flap Welding: Used to extrusion weld the flap of fusion weld in lieu of a full cap.
 - Capping: Used to repair failed seams.
 - Topping: Application of extrudate bead directly to existing seams.
 2. The following conditions shall apply to all of the above methods:
 - a. Surfaces of the polyethylene which are to be repaired shall be abraded.

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- b. All surfaces must be clean and dry at the time of the repair.
 - c. All seaming equipment and personnel used in repairing procedures shall be qualified and documented by the client's third party inspector.
 - d. All patches and caps shall extend at least 4" beyond the edge of the defect and all patches shall have rounded corners.
- C. Large Wrinkles: Large wrinkles that remain in the sheet as a result of temperature expansion or uneven surface preparation may need removal in consideration of applied dead loads on the wrinkle, etc. Should the wrinkle need removing, the lower down slope edge of the wrinkle shall be cut, overlapped and repaired as described above. Both ends of the wrinkle repair shall be patched. Caution must be taken in removing any wrinkles. Wrinkles are needed to allow for future contraction of the geomembrane, especially in cold weather.

4.7 Liner Vents

- A. The attached schematic detail DF4A / C.DF4 depicts a typical vent. Vents shall be installed in accordance with manufacturer's recommendations as well as requirements and recommendations indicated on project design drawings.

4.8 Pipe Penetrations

- A. The attached schematic detail DF4B / C.DF4 depicts a pipe penetration. Pipe penetrations shall be installed in accordance with manufacturer's recommendations as well as requirements and recommendations indicated on project design drawings.

4.9 Final Earthwork, Backfilling and Equipment

- A. Backfilling of Anchor Trench: Promptly after installation of the FML, the anchor trench shall be backfilled by the earthwork contractor or the installer, as specified in the contract. Backfilling should occur when the geomembrane is in its most contracted (taut) state. Care must be taken when backfilling to avoid damage to the FML.
- B. Construction Equipment: Construction equipment or vehicles with steel tracks shall not be permitted directly on the geomembrane liner. Vehicles with rubber tires, without a tugged tread and with a loading of less than 6.0 lbs / in² weight are allowed, provided proper care is taken when operating the vehicle to avoid stressing the geomembrane. Other equipment such as portable generators shall be permitted if the support apparatus for the equipment protects the liner from being damaged.

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5.0 QUALITY ASSURANCE AND QUALITY CONTROL

5.1 Materials:

- A. The FML installation contractor or quality control technician shall verify that the property values certified by the geomembrane manufacturer meet all of the specifications; that the measurements of properties by the geomembrane manufacturer are properly documented; and that the test methods used are acceptable.

5.2 Field Seam Testing / Quality Control

- A. The end user company, or their designated representative, reserves the right of access for inspection of any or all phases of this installation at their expense.
- B. Qualifications of personnel: All personnel performing seaming operations shall be qualified by experience. At least one welder (Master Welder) shall be on site at all times during the seal welding process and have experience seaming a minimum of 5,000,000 ft² of geomembrane. The "Master Welder" shall provide supervision of the less experienced welding technicians during seaming, patching and testing operations.
- C. Testing of coupons (strips of material) before seaming, stress cracks and all seams must be done in accordance with the FML manufacture's requirements.
- D. Trial Welds / Seams:
 - 1. Four specimens, each 1" wide and 6" apart from each other shall be cut from the trial seam. Two of the specimens shall be tested in shear and two specimens tested in peel. Both shear and peel tests shall be conducted to the yield point of the geomembrane. When testing a fusion welded seam the outside (top) weld of a split-wedge weld should be considered the primary weld and shall be the weld tested in peel. The specimen must exhibit the following properties to pass:
 - a. Shear Test: Both specimens must meet or exceed the bonded seam strength values in shear of both specimens shall exhibit a bonded seam strength in shear that is greater than 90% of the minimum yield tensile strength of the parent material.
 - b. Peel Test: Both specimens must exhibit failure of the parent material or meet or exceed the bonded seam strength values in peel, or strength values shall be greater than 70% of the minimum yield tensile strength of the parent material.
 - 2. General seaming operations may proceed prior to the test being complete. Should a trial seam fail, a sample shall be removed 3 lineal feet from the start of the seaming operations and tested per the above. This procedure will be repeated and followed until a passing sample is located. All work preceding the passing sample shall be repaired.

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E. Non-Destructive Seam Continuity Testing

1. Concept: The FML installation contractor shall non-destructively test and document all field seams over their full length using an air pressure test or vacuum test. The purpose of non-destructive tests is to check the continuity of the seams.
2. The FML installation contractor shall:
 - a. Schedule all non-destructive testing operations.
 - b. Instruct the testing personnel regarding marking of repairs needed, leaks and sign-off marks on seams and repairs.
 - c. Monitor the operations of testing personnel to ensure that procedures for testing are followed.
3. On seams that cannot be non-destructively tested by vacuum or air-pressure methods due to physical constraints, (i.e. a boot detail) the seam shall be tested using other approved methods.
4. Vacuum Testing:
 - a. Equipment:
 - Vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft gasketing material attached to the bottom, a valve assembly and a certified vacuum gauge.
 - Vacuum pumping device. Including back-up device
 - Foaming agent in solution.
 - Equipment suitable for applying the foaming agent.
 - b. Procedure:
 - Wet the section of the seam with foaming agent.
 - Place the vacuum box over the wetted area.
 - Energize the pumping apparatus.
 - Obtain a minimum pressure of -5.0 psi.
 - For a period of approximately 10 seconds, observe, through the viewing window, for the presence of soap bubbles.
 - If no bubbles are observed, reposition the box on the next area for testing.
 - If bubbles are detected, mark and document location of the leak so repairs can be made.
5. Air Pressure Testing: The following procedures are applicable for seams produced by a double-fusion welding apparatus.

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a. Equipment:

- Air pump or air tank equipped with pressure gage and capable of producing pressures between 25 to 30 psi.
- Sharp hollow needle to insert the air into the air chamber of the seam.

b. Testing Procedure:

- Installer will provide for approval a detailed seam testing map prior to the starting of seal tests.
- Seal both ends of the air channel in the seam to be tested.
- Insert the hollow needle into the air chamber at either end of the seam to be tested.
- Energize the air pump to a pressure between 25 and 30 psi and read pressure inserted into the chamber. Allow the pressure to stabilize and if necessary, re-pressurize to between 25 and 30 psi. Then record the pressure.
- Wait for a minimum of 5 minutes and then record the air pressure again.
- If the difference between the initial and the final pressure is greater than 4 psi the seam failed. Documentation required on all failed tests.
- Upon completion of all readings, open the opposite end of the seam with a needle. The escaping air will confirm that the entire length of the seam was pressurized and therefore tested.
- Upon passing the air pressure test, the seam shall be marked and documented.
- All Seam tests shall be witnessed by client or clients inspector.

c. Procedure for Air Pressure Test Failure:

- While the seam air-channel is under pressure, traverse the length of the seam and listen for the leak. Once the area of the leak has been narrowed down, apply a soapy solution to the seam edge (do not trim excess material from edge of seam) and observe for bubbles formed by escaping air.
- As an alternative to the step above the seam may be re-tested in progressively smaller increments, until the area of leakage is identified.
- Repair the identified leaking area by extrusion welding the excess material at the edge of the seam and then vacuum test.
- In areas where the air channel is closed and the integrity of the weld is not suspect, vacuum testing is acceptable.

F. Destructive Seam Testing

1. Concept: Destructive seam tests shall be performed at locations selected by client's inspectors. The purpose of these tests is to evaluate bonded seam strength. Seam strength testing shall be performed and documented as work progresses.
2. Location and Frequency: The minimum frequency of sample removal shall be one sample per 750 ft of seam. The location of the test sample will be taken no greater than 6" from the end of the seam. Additional test samples removal as requested by the client or client's inspector.

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3. Size of Samples: The size of the sample for independent testing shall be 12" by minimal length with the seam centered lengthwise. The sample shall be cut into the following segments and distributed as follows:
 - a. The first segment cut shall be 12" x 12" marked with the appropriate D/S number and given to the AQ technician for testing.
 - b. The second segment, 12" x requested length (18" max) shall be marked with the appropriate D/S number and transmitted at the contractors cost to the independent testing laboratory or the quality assurance technician personnel for their dispersal.
4. Field Testing: The segments given to the quality assurance technician shall be tested in peel and in sheer using the following criteria:
 - a. Ten specimens of 1" width shall be cut from the segment.
 - b. Five of the specimens shall be tested in a peel configuration. The outside (top) weld of a split wedge weld shall be considered the primary weld and shall be the weld tested in peel.
 - c. Five of the specimens shall be tested in a shear configuration.
 - d. The geomembrane manufacturer shall supply a field tensiometer equipped with a drive / pull apparatus adjusted to a pull rate of 2"/min to 20"/min and a means of measuring the strength of the sample.
 - e. Pass Fail Criteria: The installers sample will pass when:
 - The peel specimens exhibit failure of the parent material.
 - The bonded strength peel values shall be greater than or equal to 70% of the minimum yield tensile strength of the parent material.
 - The shear specimens display parent material failure.
 - If the bonded seam strength in shear values is not listed, the shear values shall be greater than or equal to 90% of the minimum yield tensile strength of the parent material.

Note: Locus of break determinations is to be in accordance with ANSI/NSF 54

 - Four out of five specimens meeting the above criteria constitute a passing test.
 - f. Procedure for Failing Tests:
 - Two samples of the same size shall be removed from the failed seam. The first sample shall be removed 10 lineal feet in front of the failed sample and the second shall be removed from behind the failed sample.
 - Label the samples A and B and test in accordance with procedures listed above.

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- If both samples A and B pass, seam between the location of samples A and B shall have the flap extrusion welded or be capped and non-destructively tested accordingly.
- If either sample A or B fails, additional samples shall be taken a minimum distance of 10 feet away from the failed test location. Testing shall continue as outlined above until the area of incorrect seam is isolated.
- In lieu of taking an excessive number of samples, the installer may opt at their cost to extrusion weld the flap or cap for the entire length of the seam then non-destructively test the seam.
- All failing tests shall be documented and forwarded to the client or client's representative within 24 hours, along with recommendation of correction

5.3 Defects and Repairs

- A. Identification: All seams and non-seam areas of the polyethylene lining system shall be examined for defects in the seam or sheet.
- B. Identification of the defect may be made by marking on the sheet/seam with paint or other marks. The following procedure shall be followed:
 1. For any defect in the seam or sheet that is an actual breach (hole) larger than $\frac{1}{4}$ " in the liner system, the installer personnel shall circle the defect and mark the letter "P" inside the circle. The letter "P" indicates that a patch is required.
 2. For any defect in the seam or sheet that is less than a $\frac{1}{4}$ " hole, the installer personnel shall only circle the defect indicating that the repair method may be only an extruded bead and a patch may not necessarily be required. Repair methods will be at the sole discretion of the client and the client's qualified inspection representative.
- C. Unless otherwise specified, only the geomembrane installation contractor or quality assurance technician shall be permitted to mark on the liner system. The quality assurance technician shall use markings that are distinguishable from the geomembrane installation contractor markings.
- D. Verification of Repairs: Each repair shall be non-destructively tested in accordance with requirements of these specifications and manufacturer's recommendations. Once passing tests are achieved a marking shall be placed on the repair, indicating the test is complete and the area has passed the test. If defects remain, appropriate markings shall be made to clearly indicate that additional repairs are required.

5.4 Final Approval

- A. A final inspection of the completed liner will be conducted by the FML installation contractor, quality assurance technician and project manager / owner. This careful evaluation will occur before the Division of Water Quality is asked to approve the use of the lined lagoon. The purpose of the inspections is to verify the following:
 1. All repairs have been appropriately performed.

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2. All test results are positive.
 3. Area is free of scrap, trash and debris.
 4. Anchor trench has been properly backfilled.
 5. Liner has been installed according to the requirements of these specifications, the project documents and the manufacturer's recommendations.
 6. Four (4) copies in three ring binders of all installation record documents will be required prior to final acceptance.
- B. Each liner material test, construction inspection checklist, data sheet, or narrative report will be preserved for inspection by the Division of Water Quality. Waste shall not be discharged into the digesters or equalization basins prior to the approval of the Division of Water Quality.

6.0 Warranty and Guarantee

- 6.1 The manufacture / Installer shall provide a written warranty in accordance with the requirements specified by the owner and / or design engineer.



DWQ-2017-001975

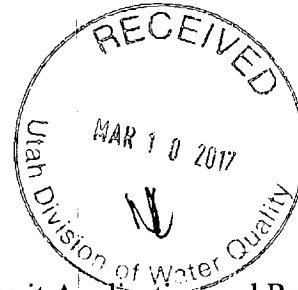
GEM ENGINEERING, INC.

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www.gemengineeringinc.com

February 28, 2017

Division of Water Quality

Utah Department of Environmental Quality
Salt Lake City, Utah 84114-4870



Subject: Addendum # 1 - Groundwater Discharge Permit Application and Report
Dated January 6, 2017 - GEM Report # RE0469
For Smithfield Hog Production
Pinnacle Finisher Farm Sites
North-Northeast of Milford, Millard and Beaver Counties, Utah

We are providing to the State of Utah Division of Water Quality this addendum to the subject groundwater discharge permit application. Since the submittal of the subject report Smithfield Hog Productions desires to expand the permit to include the following two additional items:

1. The subject permit application originally was requesting permitting for a total of 33 farm site plus a truck wash facility. It is now desired to have a total of 52 farm sites plus a truck wash facility. We are requesting that the subject application be amended to include a total 52 farm sites plus a truck wash facility. Please find enclosed a site map showing the new locations of the sites with the associated farm site number and a new table with the latitude and longitude for each of the sites.
2. Smithfield Hog Production also desires to have the option of constructing digesters at any of the permitted sites. This will require a secondary evaporative basin which will evaporate the excess waste water not utilized in the digester. We have designed a new secondary basin to be utilized for digester configuration. Please find attached the new digester-secondary basin design. The secondary evaporative basin can evaporate all of the flow from the site given the design criteria contained in the subject permit application. Since the construction plans for the digesters are not yet determined, the plans for the digester will be submitted when the construction permit is submitted and will be reviewed and approved by the Division of Water Quality at that time. All digesters and basins considered for the digester sites will have the same groundwater protections measures outlined in the subject permit application such as 60 mil HDPE liners, compacted soil sub-liners, monitoring wells, ect.. We are requesting that the subject application be amended to include the option of having digesters included for construction at any given site approved for the permit.

February 27, 2017

All recommendations and groundwater protection measures contained in the subject original permit application still apply to the above options.

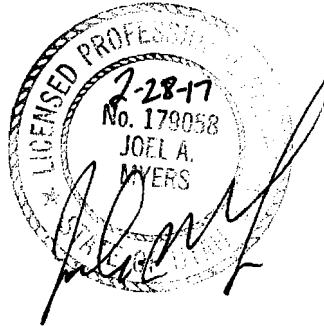
We appreciate the opportunity to be of continued service to you. If you have any questions please contact me at your convenience.

Sincerely,

GEM Engineering, Inc.



Joel A. Myers, P.E.
President



Pinnacle Farm Site Locations

Site	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
Truck Wash	38	28	26	112	57	11
1	38	28	26	112	58	14
2	38	28	14	112	56	20
3	38	28	52	112	56	21
4	38	29	4	112	57	25
5	38	29	5	112	58	14
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8	38	30	7	112	56	22
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15	38	30	28	112	54	4
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49	38	33	27	112	57	43
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51	38	34	2	112	54	22
52	38	34	41	112	54	4



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PINNACLE FINISHER SITES

LOCATION
BEAVER AND MILLARD COUNTIES, UTAH

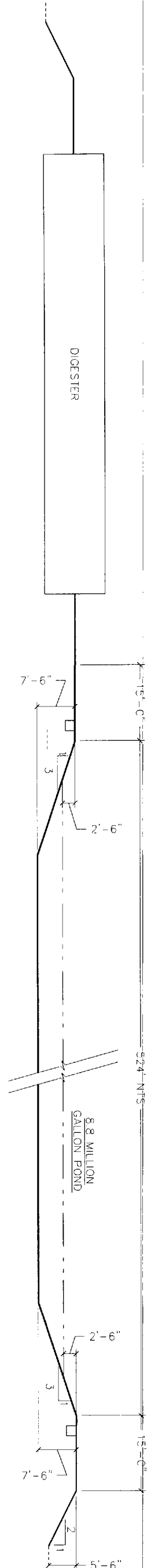
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ISSUED	DATE	DESCRIPTION
REV NO		

PROJ MGR
DESIGNER
DRAWN BY

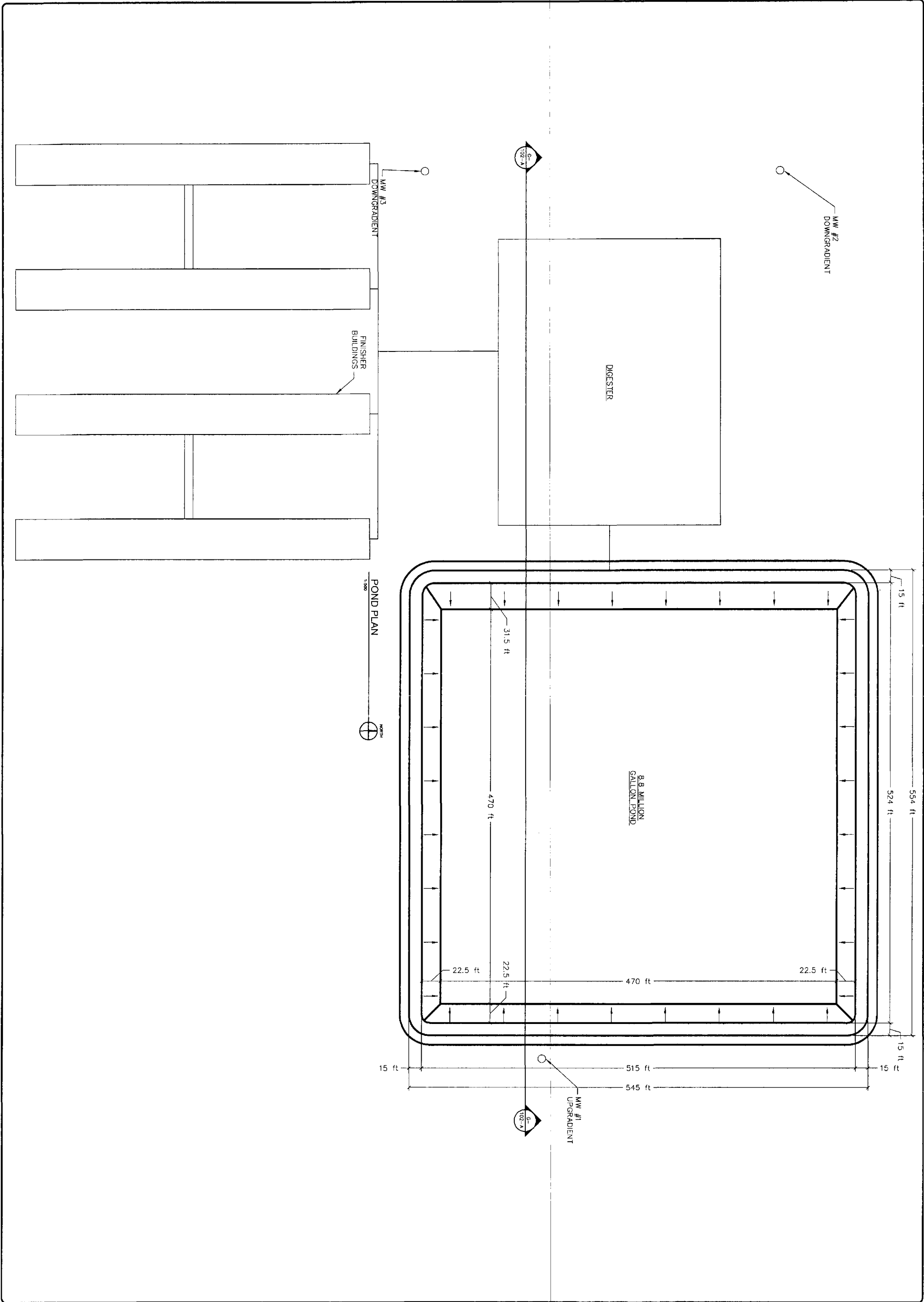
SCALE
JOB NO
DRAWING TITLE

SHEET NO
G-102-A



POND SECTION

NO SCALE



GEI ENGINEERING, INC. 485 North Aviation Way Cedar City, UT 84721 Phone (435) 867-6478 Fax (435) 867-4372 www.geiengineering.com		PINNACLE FINISHER SITES LOCATION: BEAVER AND MILLARD COUNTIES, UTAH		<p>PROJ. MGR. -- DESIGNER: RWC DRAWN BY: RWC</p> <p>SCALE: REFER TO PLAN</p> <p>DRAWING TITLE: COVERED POND PLAN AND MONITORING WELLS</p> <p>SHEET NO. G-101-A.1</p>	
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